Space Weather Forecast

Issued on Saturday, 24 December 2022 at 12:43 Local

This forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Potential Earth-directed CMEs - cursory analysis suggests arrival Monday 26 December and perhaps midweek. Risk Minor Geomagnetic Storm G1 peaking 26 December, perhaps Moderate G2.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was low over the 24 hours, with the peak X-ray flare observed being a mid-ranking common-class at 23/1446UTC from a sunspot group near the middle of the sun in the northern solar hemisphere. This sunspot region was an otherwise relatively stable group, forming a near-continuum magnetically with a larger region to its west. This western group itself saw significant growth and proliferation in its trailing spots, eventually producing the two other middling C-class flares of the period, discussed below as possible progenitors of Coronal Mass Ejections (CMEs). The above were two of five sunspot regions on the Sun, although the remainder were magnetically less complex, stable, and unproductive in terms of X-ray flares.

The past 24 hours have been eventful in terms of potential CMEs, and the remainder of this section discusses this.

Ongoing at the start of the 24 hours around 23/1200UTC, was a large 'filament eruption' (arc of plasma on the Sun's facing side) from the southwest of the Sun. Along with a 'prominence eruption' (arc of plasma on the Sun's edge) seen around 23/1900UTC from the northeastern solar horizon, both events have been analysed and are considered misses. Around 23/2330UTC, a disappearing solar filament was then observed near the solar meridian in the southern solar hemisphere. A tentative analysis has been attempted based on limited imagery, with some hints of grazing incidence possible on 28 December. This will be re-analysed should imagery improve.

Potentially the most noteworthy event of the 24 hours then occurred at 24/0230UTC in an eruptive filament in the northeast. At least some of the ejecta appears to be directed centred north and east of the Sun-Earth line, however the shock at least intersects the solar meridian, and an Earth-directed component is considered likely.

The final event(s) noted in the period were a 'disappearing filament' near the northern solar pole at 24/1100UTC and possible ejecta emerging from the leading spot of the largest group at 24/0400UTC and again at 24/0800UTC, tied to impulsive mid-ranking Common-class X-ray flares. There is not yet any confirmatory imagery of CMEs from any of these events, with monitoring ongoing.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

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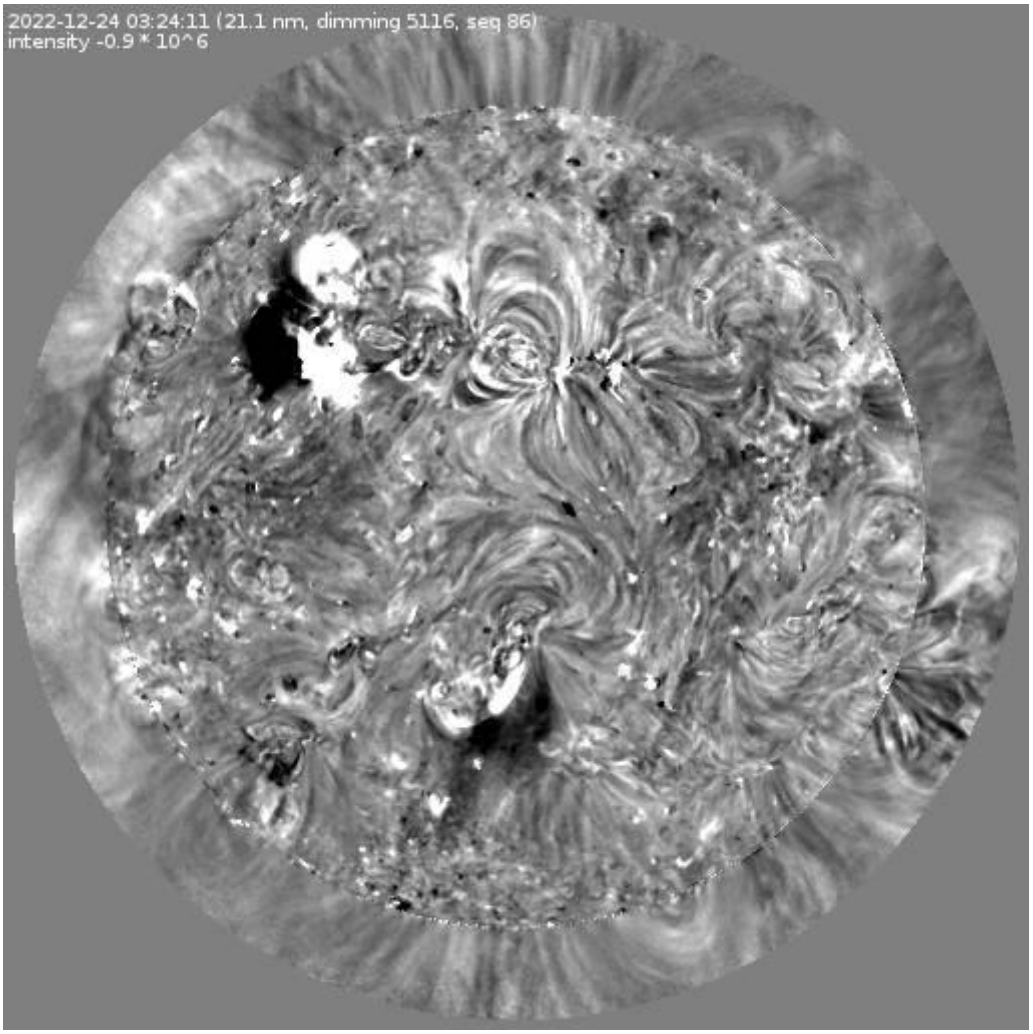

Figure 1: Extreme UV time-integrated image to 24/0324UTC of footprints of two 'disappearing filaments' of interest – firstly the south centre disc eruption 23/2330UTC; and secondly the northeast disc 24/0230UTC event. Of these, the latter is considered the greater risk for geomagnetic activity, perhaps due on 26 December, with its compatriot perhaps a lesser glance on 29 December. Image processing courtesy of SIDC ROB.

Solar Wind / Geomagnetic Activity: Solar winds followed an intensifying fast regime from a 'coronal hole'. Solar wind speeds increased through Elevated levels, with the number of particles in the wind a little above the long-term average. Meanwhile, the magnetic field associated with these particles was also Slightly Elevated mid-period, only beginning to wane as the UTC morning of 24 December evolved. The north-south component showed an erratic tendency, and spent no prolonged period aligned or anti-aligned with Earth's field (to lesser or greater geomagnetic effect).

The net effect of the above solar wind measures was a provisional peak of Minor Geomagnetic Storm G1 conditions in the 12-15UTC interval, with a belated possible revision upwards to this level also seen in the 21-24UTC interval.

Energetic Particles / Solar Radiation: No solar radiation storms were observed.

Four-Day Space Weather Forecast Summary

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Solar Activity: Solar activity carries a now-increased chance of Moderate-class flares throughout the forecast period, mainly due to developments in the largest sunspot group.

Solar Wind / Geomagnetic Activity: Confidence in the geomagnetic forecast is lower than average due to changes due to the number of possible CMEs, and because of changes to upcoming 'coronal holes' between 27-day passes.

In terms of CMEs, there is a pre-existing small chance of marginal interaction with a CME on the remainder of day one, 24 December. This CME originated on 21 December.

The CME picture is otherwise in a state of flux, and keeping abreast of the forecast is advised. There are now two other points of note: firstly and most significantly is the 24/0230UTC northwestern filament. Early analysis of this event suggests interaction with at least the shock and very possibly the core of the CME on 28 December. This is likely to result in the peak geomagnetic activity for the four days, probably G1 Minor Storm and perhaps G2 Moderate. A second, slower and lower confidence event in the form of a disappearing filament from the south centre of the Sun on 23/2330UTC may then give marginal effects outside the coming four-day period on 29 December. This latter event will be re-analysed should improved imagery become available.

Solar winds are otherwise forecast to be Slightly Elevated or Elevated through the period due to ongoing fast winds, both initially, but then with a further enhancement likely from day 3 or day 4 (Monday 26 or Tuesday 27 December).

The combination of all the above factors should result in a disturbed geomagnetic environment throughout, probably showing two peaks: both in the immediate term and again on Monday 26 December. The larger risk is Monday's peak, with a chance of G2, else likely G1. G1 is also rated a chance for the remainder of day one, Saturday 24 December, and in the aftermath of any CME on day four, Tuesday 27 December.

Energetic Particles / Solar Radiation: No solar radiation storms are expected, although the daily risk has been revised upwards slightly to account for recent growth in the largest sunspot group.

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Geomagnetic Storms:

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	25	5	60	25
Strong	G3	No	1	1	5	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Radio Blackouts - X Ray Flares:

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	25	25	25	25
Very Active	R3 to R5 X	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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